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FM AMEMBASSY PRETORIA
TO RUEHC/SECSTATE WASHDC 2398
INFO RUCPDC/DEPT OF COMMERCE WASHDC
RHEBAAA/DEPT OF ENERGY WASHINGTON DC
RUCNSAD/SOUTHERN AF DEVELOPMENT COMMUNITY COLLECTIVE
RUEHBJ/AMEMBASSY BEIJING 0683
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UNCLAS SECTION 01 OF 02 PRETORIA 003747

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DOE FOR T.SPERL, G.PERSON, A.BIENAWSKI, M.SCOTT, L.PARKER

E.O. 12958: N/A
TAGS: ENRG TRGY SENV KNNP PREL EINV SF
SUBJECT: NUCLEAR POWER: BIG DREAMS FOR SMALL PEBBLES - PBMR

REF: A) Pretoria 3507
B) Pretoria 3078
C) Pretoria 3012

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¶1. (SBU) SUMMARY: South Africa's Pebble Bed Modular Reactor (PBMR) new nuclear technology will play a key role in the SAG decision to significantly increase nuclear power generation in the country over the next 20 years. The country will face challenges in securing skills and investment to implement its ambitious program. PBMR is a leading contender for high-temperature, gas-cooled Next Generation Nuclear Plants, in cooperation with Westinghouse and the DOE Idaho National Laboratory. Embassy joined an Idaho National Laboratory mission to check the status of PBMR. End Summary.

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Our Smart Nuclear Guys Talk to Their Smart Guys
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¶2. (SBU) Energy Officer and Energy Specialist joined a delegation from the DOE Idaho National Laboratory (INL) to visit test facilities of the Pebble Bed Modular Reactor (PBMR) on October 19 and 22. INL is working on the Next Generation Nuclear Plant (NGNP) and Generation IV nuclear reactor for which PBMR is a leading contender because of high efficiency, attractive economics, modular size, and enhanced passive safety features.

¶3. (U) The PBMR is a High Temperature Reactor (HTR) with a closed-cycle, gas turbine power conversion system. The fuel consists of low enriched uranium triple-coated "kernels" contained in molded graphite spheres, the so-called "pebbles". Each fuel pebble contains 9 grams of nine percent uranium-235. About 450,000 of these tennis-ball-sized spheres circulate through the reactor. Helium coolant circulates among the reacting spheres and heats up to a temperature of 900 degrees centigrade in order to remove the heat generated by the nuclear reaction. The heated gas drives a power-turbine-compressor to generate electricity and then passes through a high efficiency recuperator. PBMR is designed to be inherently safe with passive features that assure no danger of overheating, meltdown, or release of fissile materials.

¶4. (SBU) The host of the INL visit, PBMR Chief Technology Officer Dr. Johan Slabber, was an early champion of the vision of acquiring

the pebble bed technology from the Germans, eventually convincing state electricity company Eskom to form PBMR Ltd in 2000. Current investors are the South African Government (SAG), Eskom, the Industrial Development Corporation (IDC) of South Africa, and Westinghouse, which took over the 15 percent share previously held by British Nuclear Fuels (BNFL). Original investor U.S. firm Exelon ended its investment for strategic reasons.

South African Government Commitment

¶5. (SBU) The South African Government has embraced ambitious plans to double its electricity capacity from current 42,000 MW to 82,000 MW by 2025, documented by publication of its draft nuclear energy policy and reassessment of its overall energy policy (reftels). In addition, 25 percent of total capacity will be generated by nuclear power. This will constitute about 18,000 MW of nuclear new-build, of which Westinghouse and Areva of France are competing for the first tranche of 3,000 MW (reftel B). If realized, South Africa's new nuclear build will represent 17 percent of the world's anticipated nuclear new build over the same period. The SAG is contemplating PBMR technology for up to 5,000 MW of its nuclear new build. The SAG's nuclear energy policy is also premised on beneficiating its prodigious uranium reserves, about 10 percent of the world's supply, as well as maintaining security of fuel supply by considering developing fuel enrichment capability. Despite the huge investment contemplated, South Africa has significant existing infrastructure with one nuclear power plant, a respected National Nuclear Regulator (NNR), the Nuclear Energy Company of South Africa (NECSA) at Pelindaba, waste disposal facilities, and extensive expertise and training capacity.

¶6. (SBU) The Embassy/INL team visited PBMR test facilities at Northwest University and M-Tech in Potschefstroom on October 19. These included the Pebble Bed Micro Model, the Heat Transfer Test Facility (high pressure and high temperature testing of thermal properties of gas coolant), and hydrogen hub testing. The team visited additional PBMR testing facilities at NECSA-Pelindaba near Pretoria on October 22. The pilot fuel plant and kernel laboratory is engaged in detailed research and analysis of the pebble spheres. Chief Technology Officer Dr. Johan Slabber said he expects to imminently secure the license to allow them to use uranium instead of zirconium for testing. The Helium Test Facility is a full-scale facility for testing the circulation of the pebble spheres within high temperature helium gas. This facility was constructed by South African nuclear supplier company IST-Nuclear, which was recently acquired by Westinghouse. IST-Nuclear will become Westinghouse Electric S.A. on November 1.

¶7. (SBU) Pelindaba is also the former site of South Africa's weapons and uranium enrichment program, voluntarily dismantled in the late 1980's. The SAG has since signed and adhered to all non-proliferation conventions. The SAG is in the process of converting the existing Safari Research Reactor at Pelindaba from high enriched uranium to low enriched uranium. The highly secure Pelindaba facility declined in the years following decommissioning of the weapons facilities, but PBMR is participating in a renaissance of the facility.

Next Steps for PBMR

¶8. (SBU) PBMR aims to develop and market small-scale modular high-temperature reactors both in South Africa and internationally. Since 2004, the SAG has allocated significant funding to the project and Minister of Public Enterprises Alec Erwin has voiced the SAG intent to develop up to 5,000 MW of PBMR reactors in the country (perhaps 20-30 PBMR reactors of 165 MW each). The company plans to begin construction of the demonstration reactor project at Koeberg near Cape Town in 2009 for operation in 2013. PBMR is working closely with the national regulator NNR for staged licensing of construction/installation, fuel loading, operation, and

decommissioning. The PBMR design, materials, and construction replicate previous German engineering in order to expedite regulatory approval. Demo plant client Eskom is completing a comprehensive Environmental Impact Assessment (EIA), subsequent to the Cape High Court ruling in favor of anti-nuclear Earthlife Africa to set aside an older approved EIA. PBMR officials are confident that building the demo plant will not face further delays, noting that South Africa's public is not generally opposed to nuclear power.

¶9. (SBU) COMMENT: The PBMR team takes great pride in the importance of their work and how it fits into South African economic development. Like both Eskom and Sasol, the company plans to staff up significantly, from current 1,000 employees to 5,000 staff. As remarked recently by Finance Minister Trevor Manuel, South Africa faces a skills shortage. Department of Minerals and Energy Chief Director: Nuclear Tseliso Maqubela recently told Economic Counselor that South Africa hopes to regain South African nuclear engineers working in the U.S. (i.e., at DOE facilities). On the other hand, the Embassy/INL team was struck by the knowledge and enthusiasm of a number of young black post-grad technicians at PBMR test facilities, supplementing the generally older white scientists. There is a shortage of nuclear engineering skills in South Africa and the situation will worsen as many older engineers are expected to retire over the next ten years. The targeted massive increase in electricity investment and supply is coming at a critical moment for Eskom, which faces capacity shortfalls, a slim reserve margin, and the need to periodically practice "load-shedding" due to under-investment in electricity capacity, partly because of past delays in SAG plans for new plants. Now there is full agreement between the SAG and the private sector of the need to move forward quickly.

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